

What is claimed is:

- 1) **A thermal protection system comprising:**
 - A) **a carbonaceous core having a first and a second surface;**
 - B) **a layer of aluminum or an alloy of aluminum coated upon said**
5 **at least said first surface;**
 - C) **a structural portion coated over said layer of aluminum or an**
aluminum alloy comprising at least one pair of alternating
layers of:
 - i) **an aluminum brazing alloy; and**
 - 10 **ii) an aluminum metal matrix composite.**
- 2) **The thermal protection system of claim 1 wherein said layer of**
aluminum or an aluminum alloy is coated upon said first surface.
- 15 3) **The thermal protection system of claim 2 wherein said carbonaceous**
core comprises a semi-crystalline, largely isotropic, porous coal-based
product produced from particulate coal exhibiting a free swell index
of between about 3.5 and about 5.0 and of a small diameter, having a
density of between about 0.1 and about 0.8 g/cm₃ and a thermal
20 **conductivity below about 1 W/m/°K.**
- 4) **The thermal protection system of claim 3 wherein said coal exhibits a**
free swell index of between about 3.75 and about 4.5.

- 4) The thermal protection system of claim 2 wherein said carbonaceous core has a compressive strength below about 6000 psi.
- 5 5) The thermal protection system of claim 2 wherein said carbonaceous core has been carbonized.
- 6) The thermal protection system of claim 2 wherein said carbonaceous core has been graphitized.
- 10 7) The thermal protection system of claim 2 further including a protective anti oxidant layer coated on said second surface.
- 8) The thermal protection system of claim 7 wherein said protective antioxidant layer comprises a member selected from the group consisting of metallic layers, and glass forming metal-halide, carbide or nitride compounds.
- 15 9) The thermal protection system of claim 7 wherein said protective antioxidant layer comprises a member selected from the group consisting of ZrB_2 , SiC, and B_4C .
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10) The thermal protection system of claim 7 wherein said carbonaceous core comprises a semi-crystalline, largely isotropic, porous coal-based product produced from particulate coal exhibiting a free swell index of between about 3.5 and about 5.0 and of a small diameter, having a density of between about 0.1 and about 0.8 g/cm₃ and a thermal conductivity below about 1 W/m/°K.

9) The thermal protection system of claim 10 wherein said coal exhibits a free swell index of between about 3.75 and about 4.5.

10) The thermal protection system of claim 7 wherein said carbonaceous core has a compressive strength below about 6000 psi.

11) The thermal protection system of claim 7 wherein said carbonaceous core has been carbonized.

12) The thermal protection system of claim 7 wherein said carbonaceous core has been graphitized.

13) The thermal protection system of claim 2 further including an anti oxidant blended into said carbonaceous core.

- 14) The thermal protection system of claim 13 wherein said anti oxidant comprises a member selected from the group consisting of glass forming metal-halide, carbide or nitride compounds.
- 5 15) The thermal protection system of claim 14 wherein said protective antioxidant layer comprises a member selected from the group consisting of ZrB_2 , SiC , and B_4C .